

**WHAT IS CLAIMED IS:**

- 1           1.       A machine-implemented method of processing a sequence of image  
2 frames, comprising:  
3           computing respective sets of motion vectors for pairs of image frames;  
4           classifying the computed motion vectors into motion classes;  
5           identifying motion clusters in the image frames based at least in part on the  
6 motion classes; and  
7           selecting an identified motion cluster as a motion stabilization reference  
8 based on spatiotemporal consistency of the selected motion cluster across  
9 multiple image frames.
- 1           2.       The method of claim 1, wherein computing motion vectors  
2 comprises generating for pairs of image frames respective dense motion models  
3 describing motion at pixel locations with respective sets of parameter values in a  
4 motion parameter space.
- 1           3.       The method of claim 2, wherein identifying motion clusters  
2 comprises iteratively clustering motion vectors from a coarse image frame  
3 resolution level to a fine image frame resolution level.
- 1           4.       The method of claim 3, wherein at each image frame resolution  
2 level motion vectors are classified into motion clusters, and spatiotemporal  
3 consistency is determined for each cluster in a given image frame based on a  
4 projection of the motion cluster into a neighboring image frame using computed  
5 inter-frame motion
- 1           5.       The method of claim 4, wherein the spatiotemporal consistency is  
2 determined based on degree of overlap between a motion cluster projected from  
3 the given image frame and a corresponding motion cluster in a neighboring image  
4 frame.
- 1           6.       The method of claim 4, wherein motion vectors are re-classified  
2 with a modified clustering parameter in response to a determination that a  
3 computed spatiotemporal consistency measure is below a consistency threshold.

1           7.     The method of claim 3, wherein motion vectors are clustered  
2 iteratively in accordance with a clustering method.

1           8.     The method of claim 1, wherein selecting a motion cluster as a  
2 motion stabilization reference comprises projecting each motion cluster from  
3 image frames to respective neighboring image frames, and computing respective  
4 measures of spatiotemporal consistency for the projected motion clusters.

1           9.     The method of claim 1, wherein the motion cluster selected as a  
2 motion stabilization reference for a given reference image frame has a greater  
3 spatiotemporal consistency measure than other motion clusters across multiple  
4 image frames neighboring the given reference image frame.

1           10.    The method of claim 1, further comprising stabilizing the sequence  
2 of image frames with respect to a motion model computed for the motion cluster  
3 selected as the motion stabilization reference.

1           11.    A system for processing a sequence of image frames, comprising:  
2           a motion estimation module configured to compute respective sets of  
3 motion vectors for pairs of image frames;  
4           a motion classification module configured to classify the computed motion  
5 vectors into motion classes;  
6           a motion-based spatial clustering module configured to identify motion  
7 clusters in the image frames based at least in part on the motion classes; and  
8           a motion stabilization reference selection module configured to select an  
9 identified motion cluster as a motion stabilization reference based on  
10 spatiotemporal consistency of the selected motion cluster across multiple image  
11 frames.

1           12.    The system of claim 11, wherein the motion estimation module is  
2 configured to compute motion vectors by generating for pairs of image frames  
3 respective dense motion models describing motion at pixel locations with  
4 respective sets of parameter values in a motion parameter space.

1           13.    The system of claim 12, wherein the motion-based spatial clustering  
2 module is configured to identify motion clusters by iteratively clustering motion  
3 vectors from a coarse image frame resolution level to a fine image frame  
4 resolution level.

1           14.    The system of claim 13, wherein at each image frame resolution  
2 level motion vectors are classified by the motion classification module into motion  
3 clusters, and spatiotemporal consistency is determined for each cluster in a given  
4 image frame based on a projection of the motion cluster into a neighboring image  
5 frame using computed inter-frame motion

1           15.    The system of claim 14, wherein the spatiotemporal consistency is  
2 determined based on degree of overlap between a motion cluster projected from  
3 the given image frame and a corresponding motion cluster in a neighboring image  
4 frame.

1           16.    The system of claim 14, wherein the motion classification module  
2 re-classifies the motion vectors with a modified clustering parameter in response  
3 to a determination that a computed spatiotemporal consistency measure is below  
4 a consistency threshold.

1           17.    The system of claim 13, wherein the motion classification module  
2 clusters motion vectors iteratively in accordance with a clustering method.

1           18.    The system of claim 11, wherein the motion stabilization reference  
2 selection module selects a motion cluster as a motion stabilization reference by  
3 projecting each motion cluster from image frames to respective neighboring image  
4 frames and computing respective measures of spatiotemporal consistency for the  
5 projected motion clusters.

1           19.    The system of claim 11, wherein the motion stabilization reference  
2 selection module selects as a motion stabilization reference for a given reference  
3 image frame the motion cluster having a greater spatiotemporal consistency  
4 measure than other motion clusters across multiple image frames neighboring the  
5 given reference image frame.

1           20.     The system of claim 11, further comprising a motion stabilization  
2 module configured to stabilize the sequence of image frames with respect to a  
3 motion model computed for the motion cluster selected as the motion  
4 stabilization reference.

1           21.     A machine-readable medium storing machine-readable instructions  
2 for causing a machine to:  
3           compute respective sets of motion vectors for pairs of image frames;  
4           classify the computed motion vectors into motion classes;  
5           identifying motion clusters in the image frames based at least in part on the  
6 motion classes; and  
7           select an identified motion cluster as a motion stabilization reference based  
8 on spatiotemporal consistency of the selected motion cluster across multiple  
9 image frames.

1           22.     The machine-readable medium of claim 21, wherein the machine-  
2 readable instructions cause the machine to compute motion vectors by generating  
3 for pairs of image frames respective dense motion models describing motion at  
4 pixel locations with respective sets of parameter values in a motion parameter  
5 space.

1           23.     The machine-readable medium of claim 22, wherein the machine-  
2 readable instructions cause the machine to identify motion clusters by iteratively  
3 clustering motion vectors from a coarse image frame resolution level to a fine  
4 image frame resolution level.

1           24.     The machine-readable medium of claim 23, wherein at each image  
2 frame resolution level motion vectors are classified into motion clusters, and  
3 spatiotemporal consistency is determined for each cluster in a given image frame  
4 based on a projection of the motion cluster into a neighboring image frame using  
5 computed inter-frame motion

1           25.     The machine-readable medium of claim 24, wherein the  
2 spatiotemporal consistency is determined based on degree of overlap between a

3 motion cluster projected from the given image frame and a corresponding motion  
4 cluster in a neighboring image frame.

1 26. The machine-readable medium of claim 24, wherein the machine-  
2 readable instructions cause the machine to re-classify the motion vectors with a  
3 modified clustering parameter in response to a determination that a computed  
4 spatiotemporal consistency measure is below a consistency threshold.

1 27. The machine-readable medium of claim 23, wherein the machine-  
2 readable instructions cause the machine to cluster motion vectors iteratively in  
3 accordance with a clustering method.

1 28. The machine-readable medium of claim 21, wherein the machine-  
2 readable instructions cause the machine to select a motion cluster as a motion  
3 stabilization reference by projecting each motion cluster from image frames to  
4 respective neighboring image frames and computing respective measures of  
5 spatiotemporal consistency for the projected motion clusters.

1 29. The machine-readable medium of claim 21, wherein the machine-  
2 readable instructions cause the machine to select as a motion stabilization  
3 reference for a given reference image frame the motion cluster having a greater  
4 spatiotemporal consistency measure than other motion clusters across multiple  
5 image frames neighboring the given reference image frame.

1 30. The machine-readable medium of claim 21, wherein the machine-  
2 readable instructions cause the machine to stabilize the sequence of image frames  
3 with respect to a motion model computed for the motion cluster selected as the  
4 motion stabilization reference.